CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, California 91125, U.S.A.

Division of Geological and Planetary Sciences
Mail Code: 170-25

Telephone (818) 356-6504
FAX (818) 568-0935

September 30, 1992

Dr. John D. Rummel
Exobiology Program Manager, Life Sciences Division
Code SBR
NASA
Washington, D.C. 20546

Re: Final Technical Report for NASA Grant NAGW-2198

Dear Dr. Rummel,

The focus of this project was the determination of fundamental properties of volatile components in silicate liquids, in order to provide data for evaluating hypotheses about the role of early magma oceans in the origin and evolution of atmospheres on the terrestrial planets. The Exobiology Program provided one year funding that allowed this project to get going; it is now supported by the Origins of Solar Systems Program.

If you recall, one of the important (at least from my point of view) issues when this grant was funded was to help Dr. Youxue Zhang stay on in the United States rather than return to The People's Republic of China following the incidents in Tiananmen Square. In order to provide the maximum funds to keep him going here, Caltech agreed to waive overhead and you were able to fund half of his salary for a year. Thanks to you, this story has a happy ending: Dr. Zhang is now an Assistant Professor of Geology at the University of Michigan, one of the leading institutions of higher education in this country. Moreover, the work he was able to do on the diffusion of volatiles in silicate melts with the funding you provided was original and fundamental, with direct applications to understanding interactions between gas and magma and providing important insights in the underlying chemical principles underlying the seemingly complex (but actually quite simple once understood) phenomenon of water diffusion in silicate melts. On the strength of this work he has been nominated by his colleagues at the University of Michigan for the Clarke Medal, the award of the Geochemical Society for an outstanding contribution for a scientist under 35 years of age, and I have no doubt that he will be a strong contender.

A complete list of the publications resulting from Dr. Zhang's work at Caltech, all of which was partially funded by this Exobiology Grant, follows:

Journal articles

Jambon, A., Y. Zhang, and E.M. Stolper (1992) Experimental dehydration of natural obsidian and estimation of D_{H_2O} at low water contents. Geochim. Cosmochim. Acta, **56**, p. 2,931-2,935.

Zhang, Y., E.M. Stolper, and G.J. Wasserburg (1991) Diffusion of water in rhyolitic glasses. Geochim. Cosmochim. Acta, **55**, p. 441-456.

Zhang, Y., E.M. Stolper, and G.J. Wasserburg (1991) Diffusion of a multi-species component and its role in oxygen and water transport in silicates. Earth Planet. Sci. Lett., **103**, p. 228-240.

Zhang, Y. and E.M. Stolper (1991) Water diffusion in a basaltic melt. Nature, **351**, p. 306-309.

Abstracts

Zhang, Y. (1990) An approximate treatment of uphill diffusion. EOS, **71**, p. 1664-1665.
Zhang, Y. and E.M. Stolper (1991) Water diffusion in basaltic melt. EOS, **72**, p. 312.
Zhang, Y., E.M. Stolper, and G.J. Wasserburg (1989) The mechanism of water diffusion in silicate melts. EOS, **70**, p. 501.
Zhang, Y., E.M. Stolper, and P.D. Ihinger (1990) Reaction kinetics of $H_2O + O = 2OH$ and its equilibrium, revisited. V.M. Goldschmidt Conference 1990, p. 94.
Zhang, Y., E.M. Stolper, and G.J. Wasserburg (1990) Role of water during hydrothermal oxygen diffusion in minerals. EOS, **71**, p. 650.

Reprints or photocopies of all of these papers and abstracts are attached.

I want again to thank you for funding this grant. I know that you would not have funded this grant had we not proposed interesting science with relation to your program and received acceptable peer reviews, but I have also felt that your compassion and desire to help Dr. Zhang played a role in your decision to fund it. This was a humanitarian gesture that went little noticed, but that I hope you are proud of and that I will not forget.

Sincerely,

Edward Stolper

Edward Stolper
William E. Leonhard Professor of Geology